Roof Degradation Mechanisms

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Or...

How roofs wear out and why maintenance coatings prolong roof life
...or

How can I make money selling roof coatings?
Introduction
Why do roofs wear out?

- Catastrophic
- “Old Age”
Forces on a Typical Roof
Factors Affecting Roof Life

- Sunlight
- Heat
- Cold
- Freeze/Thaw
- Dead Load
- Live Load
- Moisture
Factors Affecting Roof Life

• Impact
• Hail
• Foot Traffic
• Vandalism
• Weathering (Abrasion)
• Pollution (Effluent and Acid Rain)
• Incompatible Materials
• Wind Uplift
Deterioration Mechanisms

• Membrane Movement
• Chemical Changes
  – “Everything is Chemistry” Dr. Ralph Paroli
Membrane Movement Fatigue Mechanisms

• Building Dynamics
• Light Gauge Construction
• Thermal Cycling
  – Day/Night
  – Summer/Winter
• Differential Temperatures
  – Office/ Warehouse
Membrane Movement Fatigue Mechanisms

- Freeze/Thaw
- Standing Water
  - 1 Square 1” deep at center = 135 lbs.
  - 2 Square 2” deep at center = 1082 lbs.
  - 3 Square 3” deep at center = 3632 lbs.
Physical Damage

- Foot Traffic
- Hail
- Tree Limbs
- Thermally Induced Stress
  - Seasonal
  - Diurnal
  - Freeze/Thaw Cycling
- Light Gauge Construction
Solar Spectrum
Solar Energy Spectrum

Radiative Properties of Roofing Materials
Energy from the Sun

- Ultraviolet (UV)
  - 3% of total energy
  - responsible for sunburn

- Visible (VIS)
  - 40% of total energy
  - visible light

- Infrared (IR)
  - 57% of total energy
  - felt as heat!
Degradation of a Polymer Molecule

Sun

U.V. light
Degradation of a Polymer Molecule

Sun

U.V. light

U.V. light energy distribution within molecule

products
Spectrophotometric Transmittance Curve of Colorless Plexiglas® Molding Powder in .125 Inches
Chemical Changes that Cause Membrane Deterioration

• Sunlight
  – Asphalt Degradation
    – Asphaltenes convert to Maltenes
    – Loss of Light fractions that act as plasticizers
• Aromatic Urethane
  – Uncoated sprayed foam degrades quickly due to UV exposure
• Butyl
  – Embrittlement and chalking caused by UV exposure
Chemical Changes that Cause Membrane Deterioration

• Oxygen
  – Metal Corrosion
  – Asphalt degradation ("Blown Asphalt")

• Heat (Solar Radiation)
  – Almost all chemical reactions are accelerated by heat!
  – Increased mobility and diffusion of chemicals
    • (plasticizer migration)
  – Better insulated buildings keep heat trapped in the membrane!
Degraded Asphalt
Light Asphalt Fractions Leaching Out
Asphalt Degradation Showing “Chalking”
Damaged Base Flashings
Photomicrograph of Degraded Asphalt Roof
Photomicrograph of Degraded Asphalt
APP Modified Bitumen Deterioration
Asphalt Degradation Contributors

- UV
- Heat
- Water
- Reaction of “conjugated” molecules
- Leaching out of “Light Fractions”
Single Ply Sealant Deterioration
Other Contributors
The Effects of Coatings
A successful roof coating must:

• Block UV
  – Protect itself and the underlying membrane
• Keep the membrane cool
• Act as water/weather barrier
• Prevent egress of light asphalt fractions or plasticizers
• Low temperature flexibility
• Adhesion to roofing substrate
• Expand and contract with the roof
Roof Life Extension

• Earl Scheib/Maaco Approach
  – Install one roof....maintain with coatings
• Lower Life Cycle Costs
  – More cost effective to maintain than to reroof
• Reduced AC Electricity Costs
• Reduced “Urban Heat Island” Effects
• Improved Air Quality
Why installing an acrylic coating over an existing roof is good:

• Acrylic coated roofs have tremendous longevity so less need for reroofing or recovering Earl Scheib/Maaco model
• Maintenance contracts can provide continued protection for the building owner
• Coatings can extend the roof life for the owner without major financial impact
• Maintenance expenses can be written off immediately unlike capital expenditure that must be depreciated
• Extend existing roof warranties
• EnergyStar “Cool Roofing reduces owner’s electricity bills
Acrylic Roof Coating

- Is defined as a monolithic fluid applied fully adhered single ply membrane formed in-situ over the existing membrane.
Can Installing an Acrylic Roof Coating Save My Roof?

• Yes and No

• Yes, if the membrane still retains >50% of its original integrity

• No, if it is badly embrittled or shrunk

• No, if the structural integrity (strength) has been badly compromised
Acrylic Roof Coating Over Aged Asphalt

• Protects the Asphalt from Sunlight
• Cools the roof and building interior
  – Roof lasts longer
  – Lower A/C electricity bills
  – Provides additional watertightness
  – Lowers roof life cycle costs
Photomicrograph of Degraded Asphalt Roof Uncoated and Coated
Acrylic Roof Coating Over Aged Single Ply Membrane

• Protects the Membrane From Sunlight
• Cools Roof and Building Interior
  – Roof Lasts Longer
  – Lowers A/C Electric Bills
• Provides Additional Watertightness
• Lowers Roof Life Cycle Costs
Photomicrograph of White Acrylic Coated EPDM Roof
Summary
Acrylic Coatings Can Provide

• Extended Durability
• Improved Water Resistance of the Roof Assembly
• Reduce Air Conditioning Energy Costs
• Reduce “Urban Heat Island Effect”
• Lower Life Cycle Costs
Thanks for your interest.

Questions?